DOCKET

IN THE UNITED STATES DISTRICT COURT FOR THE

SOUTHERN DISTRICT OF NEW YORK

MIDWAY MANUFACTURING COMPANY:		Deposition of
vs.	:	William T. Rusch
THE MAGNAVOX COMPANY	:	Fourth Day
and	:	74 Civ 1657 CBM
SANDERS ASSOCIATES, INC.	:	

IN THE UNITED STATES DISTRICT COURT FOR THE

NORTHERN DISTRICT OF ILLINOIS, EASTERN DIVISION

THE MAGNAVOX COMPANY, et al	:	Consolidated Actions
vs.	:	74 C 1030 74 C 2510
BALLY MANUFACTURING CORPORATION, et al	:	75 C 3153 75 C 3933

Continued deposition taken pursuant to subpoena and notice at the Sanders Associates, Inc.; Headquarters, Spit Brook Road; Nashua, New Hampshire; Thursday, February 26, 1976; commencing at nine-thirty in the forenoon.

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ORIGINAL

PRESENT:

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For Sanders Associates:

Louis Etlinger, Esq., and Richard I. Seligman, Esq., Daniel Webster Highway, South, Nashua, New Hampshire.

Stenotype Reporter:

Ronald J. Hayward

WILLIAM T. RUSCH

called as a witness, having been previously sworn, was further examined and continued his testimony as follows:

(Interrogatories by Mr. Welsh.)

Q. Mr. Rusch, when we adjourned yesterday, you were going through your notebooks and looking for entries which indicated when the electronic control concept and the concept of ping pong and the concept of ball bounce occurred to you and you got as far as page 78, I believe, of Exhibit 18; I wonder if you would continue in that search?

A. Before I start that thoroughly, I would like to add in here for the record that the other day when you were asking me what I contributed to this project, the list I gave were the main ones I could remember at that time. I might have missed some. One I think I would like to specifically call out is this bounce of a ball from a moving spot with a velocity and direction governed by the velocity and direction of the hitting spot at the time of coincidence. I consider that probably as important as the so-called wall wtr ball bounce, and at least from a viewer's point it is a somewhat different action. Now, to continue looking for these other items, I am on page 78 of Exhibit 18. I don't know if I discussed this page at our last meeting. As

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it states on the bottom of the page, it is a method of giving control of the ball to one of several players after he hits the ball.

Q. Could you explain in some little more detail than is apparent from this page how that is accomplished?

A. That is the same as one other figure which was pretty much like this which we discussed earlier on some other page, but I can go through it again. If you look at the figure you will see two upper potentiometers connected to the two outputs of the flipflop through pairs of diodes pointing to the right. The lower potentiometers are connected to diodes pointing to the left. Thus when the voltage on the left side of the flipflop is higher than that on the right, the upper diodes conduct and those two associated potentiometers can control the ball. When the flipflop is flipped to its other state, the upper diodes are back biased and the lower diodes conduct, thus connecting the lower two potentiometers which then have control. As you can see down on the left here of the flipflop is a statement, "Flips when either player hits ball (or ball - it looks like - or other player)." It appears I wrote that

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fast, I do think the first part is clear, flipflop flips when either player hits the ball. That would thus change control from one player to the other. I am not sure just what the parenthetical statement means or was meant to mean.

Q. Now, there is an entry or there are some entries in green ink on that diagram, are there not?

A. Yes.

Q. Would you explain what those are?

A. Well, on the right, middle portion of the page, written in green, are the words "ball H and ball V." These would be the voltages which control the horizontal and vertical positions of the ball. As the title at the top of the page indicates, apparently I was trying to use ganged pots. By that, I mean at least two potentiometers connected to a common shaft. You see written in green in two places the word "ganged" and with a green line connecting the arrows or center arms to potentiometers. Similarly just above the box marked "flipflop" are two green dashed lines indicating two more pairs of potentiometers, each pair ganged or connected to a common shaft.

Q. What is the purpose of the ganged pots?

A. I am just now trying to figure that out. Referring to the upper two potentiometers above the flipflop which is apparently ganged as shown by the green line to their center arms, it would appear when the flipflop is in such a state that the diodes permit the second from the top of these two ganged potentiometers to have control of the ball, that the ball would then be forced to move to the same horizontal position called H1 as that of the spot shown as P1. Also at that time the vertical position of the ball would apparently be forced to be the same as the vertical position of active spot P1. I can't really see what this ganging accomplishes, it looks like it may have been an afterthought being that it was added in green, although I believe I may have had some intent in mind that I don't recall right now.

Q. Now, the note at the top says ganged pots for soccer, etc., hockey?

A. That is correct.

Q. Does that help you determine what the ganging might have been for?

A. Not really. I did see that title there while I was looking at this page.

Q. Would the items on the next page have any relation to that?

A. Yes, that helps a little bit. The notation to have the ball on faster time constant than player and the associated explanation underneath the little diagram there indicates that the player and the ball after making contact would eventually end up at the same position, but if different time constants were involved, one of them would get there faster than the other. This apparently is an attempt as it says there to get this kicking or bouncing action of a spot and a ball. For instance, if the time constant of the ball were made faster than that of the player and after contact the ball would take off towards its destination rapidly, the kicking spot would eventually get to that same destination, but slower and as indicated here if the other player called player 2 intercepts the ball; in other words, if he makes contact with it, then the ball gets "kicked" in the direction he is heading. And then underneath those words there is a diagram apparently

indicating just what I have talked about showing a faster time constant for the ball, a slower time constant for the player, but with both of them ending up at the same voltage which would bring them to the same position. The next item would use the same technique I said for hockey. The players' time constant would be set faster than that of the ball or, in this case, the puck, so when he obtained control of the ball, the ball would follow behind him.

Q. What do the stars on page 78 mean?

A. It looks like I apparently liked this idea at the time that I wrote it down. WFC 5/25/76

Q. You mean the idea of the control of the ball going back and forth between the players or the ganging idea?

A. Apparently the whole thing.

Q. All right; could you go on?

A. I might point out in the center of page 81 it looks like this concept of kicking a ball or bouncing it off of what in this case was referred to as a cue ball spot is under development or under mental development, you might say. WFC 5/25/76 WFC 5/25/76

Q. Calling your attention to the bottom, left corner of page 80 and recalling that you were looking for any indication of concept of either ping pong type of game or wall bounce, the question is, Does that entry in the lower left portion of page 80 have any relation to any of those items?

A. I'd say yes. In green is written the word "billiards" with a question mark after it and the diagram under it seems to show a billiard game which I had played before when I was in college. It is a game invelving, if I remember correctly, a red ball, a clear white ball and a white ball with a spot on it. And the two white balls are referred to as cue balls, each one controlled by a different player. This diagram apparently shows the cue ball with the black spot on it being hit by a player bouncing off of the other cue ball and one of the sides of the billiard table to another side, a third side, a fourth side and then eventually hitting the red ball which is one of the ways in which one scores in that game. So I think it, as indicated, shows that I was thinking at the time it would be nice if we could simulate this game electronically.

Q. Would the lines outlining the rectangle indicate the cushions of the billiard table?

A. Yes.

Q. And you contemplated the ball bouncing off of such lines?

A. Yes, just as it bounces off of the cushions on the billiard table.

Q. And that is indicated with the lines within the billiard table showing the path of the ball?

A. To me, at any rate, yes.

Q. Now, that is related to what you have termed your wall bounce feature?

A. Where those lines hit the four lines of the rectangle, I would call it wall bounce. Where the cue ball is shown - excuse me, where the cue ball with the would be black spot is shown hitting the other cue ball is still a bouncing action, but again it is semantics, but that could be rather important, I suppose. That I wouldn't consider wall bounce and to me a cue ball sitting there is not quite the same as a wall, but electronically the functions wouldn't differ too much.

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Q. In answer to the question as to what you considered

to be your contributions to the TV game development, you indicated that one of them was the wall bounce feature. Could you describe what the wall bounce feature is or was at the time you considered it, the contribution?

A. You mean from a viewers operational standpoint as opposed to the circuitry involved?

Q. Yes.

A. It is hard to tell what I believed at that time as opposed to what I believe at this time, but I think I meant when a moving spot or ball approached the surface or some electronic barrier on a screen which normally would be a certain voltage level, a certain time in the sweep voltage, for instance, with a certain angle of incidence as we used to say in my optics and physics course, that after touching this other surface or object, it would move away from that surface or object with an angle of reflection equal to the angle of incidence. In my mind, at least, this differs from the other contribution which I tried to get in the record earlier this morning where if two spots simulating, for instance, a ball and a player approaching it made coincidence, that

the ball spot would move away from the hitting spot going in the same direction as the hitting spot was, but not with an angle of reflection equal to the angle of incidence. So I consider them at least in my mind as two separate features. In this billiard game shown on page 80 where this cue ball with the black spot hits the white cue ball, that I think at least electronically is similar to the wall bounce thing in that as the rather crude diagram shows, it looks like or at least I intended it to look like the cue ball with the black spot would bounce off the white cue ball with an angle of reflection equal to its angle of incidence, the white cue ball was stationary.

Q. Could you describe how you obtained that wall bounce electronically?

A. At the moment rather vaguely, not having really come to that in the notebooks, it involved changing the sine or polarity of the deflection voltage of the moving spot - - - Excuse me, that is wrong. It involved changing the direction or slope, changing the sine of the slope of the voltage controlling the moving spot at the instant when it made coincidence

with this other surface spot, wall, what have you. By keeping the same slope, but changing its sine, the velocity of the moving spot would be the same before and after hitting the second electronic surface orwhat have you. But as can be seen, if this description were applied to a ball moving up, it would naturally reverse direction after hitting the second surface and start moving down, but its velocity or the magnitude of its velocity, its speed, (as we say in the trade), would remain constant.

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Q. What did you contemplate would constitute the electronic barrier or surface?

MR. WILLIAMS: This was at the time of recording page 80?

MR. WELSH: At the time the concept of wall bounce came to you.

THE WITNESS: I don't know exactly which day that concept came to me, I can refer to page 80 and say, for instance, I would envision or I believe I did envision this white cue ball and indeed all three of the billiard balls as being electronically generated spots. The solid lines of the rectangle would be the extremities of

the CRT face which in that case would simulate the billiard table.

Q. Now, that rectangle there shows elongation vertically, does it not, did you possibly contemplate displaying an image of a rectangle on the screen within the edges of the screen?

A. It is possible, I don't know at that time if I made that distinction in my mind.

Q. Calling your attention to page 55 of Exhibit 18 in the upper portion, are there electronic barriers such as you contemplated with wall bounce shown there?

A. Yes, I believe we did discuss them previously.

Q. Those were the grid ones?

A. Yes.

Q. And they are images displayed on the screen within the edges of the screen?

A. Yes.

Q. Is it not correct, then, that you contemplated wall bounce off of images on the screen as well as off the edges of the screen?

A. It is possible, although this diagram on page 80 doesn't really show which of the two ways I was

thinking of.

Q. But the diagram on page 55 does show a bouncing off of images on the screen?

A. Yes.

Q. Could you go on with your search for entries indicating when you conceived these various concepts?

A. Well, you see on page 83 I was apparently still trying to develop the concept. I knew what I wanted the spots to do, but apparently I didn't quite know how to have them do it at that time. For instance, I said, "When can I get ball bounce action, etc., so apparently I was trying to figure out a way to do it. I might mention page 88 in case some day I see someone building this one, that was a ping pong game similar to the one that we had discussed before with a ball and two paddles, but instead of the paddles just being able to move vertically, they would be connected to joy sticks so that they could indeed simulate a real paddle better. For that to happen, this so-called kicking action would have had to be developed as it eventually was, but it could be used for that game, too.

Q. By kicking action, do you mean the feature that the ball will rebound at a speed proportional to the speed of the image which hits it?

A. I don't quite like the word "rebound," but, yes, the intent; that is, as I said before, when the hitting spot touches the ball spot, the ball is made to move in the same direction as the hitting spot was going and with a velocity proportional to that of the hitting spot. In the case in which the ball spot was indeed moving prior to being hit, I would replace your word "rebound" with the word "bounce," perhaps. In the case - or let me state it this way - another case would be covered by this same so-called kicking action if the ball spot was not moving, but standing still and was hit by a moving kicking spot or hitting spot, then the ball spot would still move in the direction it was kicked, etc. I guess I didn't mention differentiators before, I will now. On page 89 are shown two squares with d/dt in them which I used to signify differentiators. Obvicusly this was a method of getting voltages proportional to the horizontal velocity of a moving spot and another voltage proportional to its vertical velocity.

These were used to control at least the initial velocity of the ball being hit or kicked, both in terms of the absolute magnitude of velocity or speed, and direction, in that both horizontal and vertical components were retained and used. It may be important to point out that at the bottom of page 89 another feature of this kicking action, which* I don't think I mentioned, is that the distance the ball traveled was proportional (or could be in certain games? terms if so desired) - the distance was proportional to the magnitude of the hitter's velocity at the time of contact. That is shown by the comment "ball's speed, direction and distance proportional to your motion at the time of contact."

MR. WELSH: Off the record.

(Discussion off the record.)

Q. Would you go on, please?

A. The next page, page 90, appears to be just more work on this kicking or stroking action as I apparently also called it at the time.

Q. At the top of page 90 appears an exclamation point with the word "breakthru!" To what were you

w/r/t possible word reversal, for clarity and punct. 5/25/76

OK w/r/t

OK w/r/t

Possible misquote w/r/t 5/25/76

( ) added for clarity w/r/t 5/25/76

* "which" refers to "another feature" w/r/t 5/25/76

referring or what did that mean?

A. I think it meant that I was happy that I had finally conceived of a method which conceptually looked like it would give this result which I also apparently desired rather strongly at the time. Shall I go on?

Q. Yes, please.

A. At the top of page 91 and the application 1, pool, I see I used the word "nudge" which may have been one reason for my rather exuberant use of the big red breakthrough letters on page 90. One of these exhibits I think showed way back in March or May, sometime way back in 1967, in the memo to Ralph Baer, I referred to trying to nudge golf balls and hockey pucks and things like that and this page 91 is dated 11-21, so it was for several months that I wanted to do this thing and it looked like it was possible at this time. No. 2, ping pong, would be a bit more sophisticated version than some of these that we have described and most of us have seen around this nation by now in that the ball's direction and speed would be set by your direction as written there, meaning the paddle's direction or playing spot

when you hit it. No. 3, soccer, would be another application of this stroking action or kicking action. The lower item, No. 4, which I labeled ping pong (tennis)(badminton) over net would be another application. I am sure you will ask me or I think you will ask me if the net was an overlay or on the screen. It probably could have been either. I think in this case I cover the possibility of it being an electronically generated net in that the comment at the bottom says that the ball disappears or color changes if hit net or ground and that would require an electronic net to detect coincidence of the ball and the net.

Q. Is not the curved motion of the ball indicated on that bottom figure of page 91 of Exhibit 18 a different motion than the ball motion noted previously?

A. Partially.

Q. In other words, previously did not the ball move in a straight path unless the player manipulated the English control?

A. That is correct.

Q. Excuse me, I think I interrupted you.

A. I think what I was trying to say was that the motion is partially the same in that the initial direction and velocity of the ball would be governed by the velocity of the paddle and the intermediate and final direction of the ball would be governed, then, by something else, in this case, as shown by the comment in the lower right of that page, apparently I was talking about a storage capacitor discharging which would let the ball fall as that voltage decayed.

Q. That was a simulation of gravity action, was it not?

A. Yes.

MR. WELSH: Let's take a break at this time.

(Whereupon, a recess was taken.)

Q. Did you finish your comments, Mr. Rusch, with respect to page 91?

A. Yes.

Q. Would you go on?

A. On pages 92 and 93 are more possible applications

based on that kicking or stroking principle.

Q. In the upper left corner of page 94 appears to be a diagram and the notation "space ship going through space," what did you contemplate with respect to that?

MR. WILLIAMS: Excuse me, would you repeat the question, please?

(Whereupon, the previous question was read back by the reporter.)

THE WITNESS: Well, as shown there, apparently one spot would represent, as stated, a space ship going through space and there appear to be other spots which would probably simulate stars, planets, etc. I see a note connected to one of them with a curved line stating, "get bigger and disappear." I guess I envisioned these other spots suddenly appearing on the screen, small ones simulating distant stars and getting bigger as they were approached.

Q. What did you contemplate that the individual or individuals would do in connection with that display?

A. I don't remember. I don't see any notation there. It is possible they would have blown the space ship up, something like that.

Q. Are you familiar with a game played on a cathode ray tube display called "Space War"?

A. No.

Q. Have you ever heard the term "Space War"?

A. Once.

Q. When was that?

A. I can't recall the exact date, I believe it was several months ago. I was in this building in South Nashua and Mr. Ted Anderson asked me the same question as you did.

Q. Had you heard of the term prior to that?

A. Not to the best of my recollection, no.

Q. Was that before or after you received the subpoena to appear as a witness?

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A. I am quite sure it was, or I think I am quite sure, to be careful, that it was quite a while after receiving the subpoena. It was the day I first met Mr. Williams and Ted Anderson.

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Q. How long did that meeting take place?

A. I think we discussed this previously; I believe I

stated it was from a half hour to an hour or thereabouts. I don't recall exactly.

Q. Would you now go on reviewing your notes for entries involving the ping pong ball bounce and the electronic ball control concept?

A. Well, many of the things we are discussing now are related to electronic control. One at the top of page 96 shows a simulation of what I called penny arcade hockey games. That one shows a ball, or more specifically, a spot representing a puck which can travel in a confined area between the two player spots and certainly the intent was, as with most of these things that I am discussing right now, that the ball would not be controlled manually once it was put in flight by hitting either of the spots, but rather electronically. Page 97 is obviously related to this kicking action. Page 98 shows a thing which I call "true pool ball bounce" which appears to be an attempt to mathematically conceive of some way to get some of the bouncing action of one spot off another as shown on page 80 of this same exhibit. I take that back. There is a difference there. On page 80, the six-section

broken line ending in an arrowhead shows the cue ball with the black spot bouncing off the ball without a spot, but in that figure on page 80, there is no indication as to what happens to the cue ball without the spot when it is hit. This diagram on page 98 would govern what would happen to that cue ball without the spot as I made the distinction on these two pages, 80 and 98, the difference being the difference between billiards and pool and that in my mind in pool at least one is more concerned with the action of the hit ball at least directly whether it goes into a pocket or not; and I do realize the position of the cue ball is important to fine billiard players as to fine pool players. Anyhow, as shown I was attempting to make the hit ball move along a line drawn through the center of the two balls at the instant of contact and I had written in there "regardless of path of ball!" I would say this is a different action than what I had previously referred to as the kicking action. In view of your question, I probably shouldn't have even discussed it. Page 100 appears tc be another diagram involved with this

kicking or stroking action, I believe. I do see at the top of that page the word "bounce." I believe that diagram is more or less a reiteration of that shown on page 97 which was labeled "bounce" or "kick action."

Q. Before going onto Exhibit 19, was the time when Mr. Anderson mentioned Space War the only time that you have heard the term?

A. No. May I talk to Mr. Williams?

Q. Well, I would like to have you answer the question.

A. All right; I have not been through this before. Mr. Williams, as well as Mr. Anderson and yourself, also asked me the same question, Have I ever heard of Space War or had I ever heard of it? This happened, I believe, last Thursday of last week, whichever was the first day I started giving this deposition; it was during the morning of that day which I believe was Thursday.

Q. Do I understand correctly that prior to the time Mr. Anderson asked you about Space War, you had not heard the term?

A. To the best of my recollection, and I am attempting to give honest answers, that is true.

Q. I don't question that at all. Do you recall any other time than those two times prior to today when you have heard the term "Space War"?

A. I think I may have asked Mr. Harrison the same question that everyone is asking me after my initial conversation with Ted Anderson.

Q. By the same question, do you mean

A. I asked him, I said, Bill, have you ever heard of this thing called "Space War"?

Q. What did he reply?

A. I believe he replied that he had not heard about it or at any rate I don't remember his knowing enough about it to tell me what it was about.

Q. Do you now know what Space War is about?

A. I think I have a vague conception.

Q. What is that?

A. I think it is some kind of game played with a computer somehow and involving a display.

Q. Anything else?

A. Other than my assumptions of what it might be, no.

Q. What are those?

A. I have a feeling in view of your interest in one of

my diagrams of whenever it was, November sometime, showing a vehicle moving through space, that it might be something similar to that, at least as viewed by a player or the audience.

Q. Prior to this morning, did you have any idea of what Space War was about?

A. Not really other than what I have said or what I said prior to your previous question. The name itself naturally brings some connotations to mind where you would possibly think of something like a space ship and stars as this diagram I had drawn long ago before I had ever heard of a thing called Space War.

Q. Have you discussed Space War with anyone else on any other occasion than the three that you mentioned?

A. I don't recall doing so, no.

Q. Did you ever discuss it with Mr. Baer?

A. I don't think so.

Q. Could you now refer to Exhibit 19 and proceed to tell us what entries relate to these concepts and indicate when the concepts occurred?

A. These concepts still being ping pong?

Q. Ping pong, electronic control, wall bounce.

A. I would say definitely on page 2 of Exhibit 19 is shown what at that time I had called "angled bounces from sides" which shows two angles labeled "Theta" showing the equal angles of incidence and reflection to which I have previously referred. In blue on that page I wrote a note which says, " Don't need real 'cushion' can just work with voltages." This meant that what I referred to as a cushioned spot or, for example, at the top of the screen would be a long horizontal bar, perhaps some of these grid lines that we talked about, that while that could be done, I apparently was looking for a simpler way to implement this at the time and, as it says there, I apparently felt as I do now, that you can just work with the voltages which visually would mean the spot bouncing just from the edge of the TV screen whether or not, for instance, a white line was displayed along this edge.

Q. And when you just spoke of grid lines, were you referring to actual images on the screen?

A. Yes, that is what this note in blue implies to me, that this bounce could have been from images, but

at the time this was written, I felt it might be simpler to implement it quickly without doing it from such images. The bottom of that page 2 shows rather succinctly what I tried to describe in many words before, the letters Vb indicate, for instance, the vertical voltage of the ball. The rising line is noted, ball going up, and there is a dot noted, hits cushion and switches polarity of EG which is shown above as the voltage going into what is labeled as the ball vertical integrator. After hitting the cushion, the descending horizontal line was meant to have the same magnitude of slope as the ascending line. And the note says the ball goes down as fast as it was going up. At the top of page 3 is shown a case where multiple reflexions would occur from the sides or cushions of a simulated pool table, billiard table.

G Probably a subscript. Check exhibit, with 5/25/76

Q. Would that contemplate the image of the table or did you contemplate an image of the table there?

A. Possibly, but with the same intent as the blue writing on page 2, thinking that it could be done that way, but it might be simpler to get it done fast without such images.

Q. Actually there are two lines there along each side of the rectangle, each pair of lines having an arrow pointing to the word "cushion" and then left, right bottom and top?

A. That is correct.

Q. So that did contemplate, then, an actual image, did it not?

A. I wouldn't say that, it could have. I think it is quite possible that this drawing was more a drawing of a real billiard table, a real physically existing one. Certainly, in the back of my mind would be the TV representation of it. Page 3 does show, it is called a bouncing race, which would be a spot or object bouncing off what is labeled "obstacles."

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Q. At that time, which was apparently 11-30-67, the date on page 3 of Exhibit 19; did you have in mind any specific means for generating the obstacle images?

A. I believe so, or at least I knew it could be done if desired.

Q. I call your attention to page 1 of Exhibit 19 and ask, Does that not confirm what you just said, that

you knew it could be done?

A. Yes. I think even way back earlier than that, in one of these first notebooks that I ever made an entry in, indeed the square spots themselves had been generated earlier and could easily be elongated into obstacles and in any rectangular size or shape. Pages 4 and 5 show more work in an attempt to develop this bouncing action from the sides. Specifically on page 5, this blue note of page 2 is more or less corroborated by a red, or a phrase written in red, saying conditions may be used just voltages and not actual coincidence cushions on TV. Meaning that it could be done from just voltages representing the sides of the screen or actual images on the screen which would indicate coincidence. The succeeding pages up through page 9 still concentrate on this subject.

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Q. And that covers a period from November 30 until at least December 8 on page 8, is that correct?

A. Yes.

MR. WILLIAMS: Off the record.

(Discussion off the record.)

Q. Could you go on, please?

A. Page 10 dated 11-30 seems to show electronic control of a spot. Specifically the page is labeled "better way for ball bounce from moving paddle." Again I see some stars which means apparently I liked that idea and there is a comment written in green, " got it working! 12-1-67."

Q. Now, page 8 contains the date 12-8-67 and page 7 has the date 12-5-67, but page 10 has the date 11-30 and page 11 has the date 12-1; do you know any reason for these dates being out of order?

A. Notreally. Sometimes it has been my habit, although apparently not often, if I think I am going to be writing about a subject which may take at least and probably many pages of a notebook and there may be only a half page or one page vacant, I might have skipped - I can't really figure out why this was done in this particular notebook in that the entries on page 8 and 9 seem to have been done on two full pages at a later date than the entries on pages 10 and 11. It is also possible that a portion of the calculations on pages 8 and 9 may have been done at an earlier date, but not completed at that time and

then on 12-8 I may have gone back and figured it was worth completing, although now I can't really tell why. I think most of the time I did as these seem to indicate, tried to keep things in chronological order.

Q. Would you go on, please?

A. Pages 10 and 11 do seem to show a method that was probably implemented on or before 12-1-67 for permitting a moving paddle to hit a ball and at least one feature of this work as shown on the lower figure of page 11 and as stated in the text they were to give the ball a fast start after being hit and then have it slowing down to a final rest position exponentially. The small figure at the top of page 10, the upper right-hand corner, seems to indicate this may have been used for the ping pong game, although I do see a comment somewhere near the bottom of page 10, "C and A1 now are the differentiators." I believe this refers to the differentiators previously discussed in connection with the kicking or stroking action. So, in that event, this would be used more to make a ball move in the direction that the moving spot was going

when it was hit.

Q. Will you go on, please?

A. Pages 12 and 13 seem to be more of an attempt to obtain what had previously been called "pool ball bounce." Do you want me to find out where?

Q. No, that won't be necessary.

A. To deviate slightly, looking at page 14 and 15 with a date at the top of page 14 of 12-8, it indicates that perhaps I had done those pages 8 and 9 at that same time, apparently I had left them blank for some reason. Maybe through an oversight and on 12-8 needed some more pages and happened to go back and use them for some work. Pages 14 and 15 are more work involving the angle of wall bounce. Pages 16 and 17 are involved with the wall bounce as are pages 18 and 19. Page 22 is entitled "bounce from paddle and wall."

Q. Referring to page 14 and the following pages, page 14 states, "problem with wall bounce if hit up toward top wall and get bounce - - - Then due to slope reversal of ball control, must hit down to make ball go up. This is N. G.! for ping pong, hockey, etc."

Q. Can you tell in the following pages up to page 23 whether that problem was solved?

A. It is possible that it was as shown by the comment on page 16 saying, "When ball stops, set up polarity going to integrator as had initially - so if hit ball up, it will go up (not down)."

Q. Now, on the pages following 24 up through 63 which I believe you indicated was the end of your notebook entries for work on the TV games, do you find any other references to wall bounce?

A. This is from page 24 through 63?

Q. Yes.

A. It is not referred to specifically on page 30; there is an outlined item which we had covered previously, TV five-man team hockey - sell to bars and clubs, and the intent of that was certainly to have wall bounce to simulate the boards of a hockey rink. I see on page 33 the diagram showing several spots and arrows and a comment "couple in with hockey bounce." A diagram on page 34 showing pinball with score column indicates various bouncing actions of the ball. I may note that I am not reading every word on every one of these pages at this time, but

more or less scanning and looking for words or diagrams which seem to spring out to me. I have not come across any more references to the wall bounce up to page 63 scanning it as I have just indicated.

Q. Was the wall bounce feature implemented at the time that you were working on it apparently most heavily from November 30, which is the date of page 3 of Exhibit 19, until December 11, 1967, the date of page 22?

MR. WILLIAMS: Well, I object to the question. The witness hasn't testified using terms that he worked on that feature apparently most heavily during that period.

MR. WELSH: Well, those are the dates of the pages with which he has entries with respect to that feature.

MR. WILLIAMS: That may be, but I don't think that is an accurate characterization of the witness's testimony.

THE WITNESS: If I exclude the words "most heavily worked on," shall I answer the question?

MR. WILLIAMS: You may answer the question, yes.

THE WITNESS: This was from pages what to what?

Q. Pages 2 through 22.

A. I can't really tell from this exhibit. It may have been. I see some notes indicating it might have been implemented or at least part of it - - - For instance, on page 19 there is a figure circled in red with a comment, "does this," with an arrow down to an exponential wave form which would give the slowing action to a moving ball that had been hit.

Q. That relates to the other feature, doesn't it, of the ball moving in the direction of the hitting spot?

A. Yes. The title of those two pages, pages 18 and 19, is wall bounce and apparently an attempt was being made to incorporate both these features at the same time. I see at the bottom of page 18 a comment, "now, when ball hits left or right wall after being hit by paddle - flip horizontal flipflop to minus one position so ball bounces off wall.

Same for vertical flipflop if hit top or bottom wall." I can't really say for sure from that whether this was a conceptual idea that made me say that that would work or whether indeed this was being implemented at the time so that I could see from real circuitry whether these things happened.

Q. If it had been implemented, who would have done the implementation?

A. Most probably Bill Harrison or quite probably Bill Harrison.

Q. I'd like to ask you to look at his notes which appear to cover that same period of time and see if you can find in there any indication of implementation of the wall bounce feature. I haven't looked through this whole exhibit, but I started more or less around the time of 11-30.

Q. Page 2 of Exhibit 19?

A. Yes, at which time it seemed that this concept was coming in mind. I don't know if we had any earlier references to it.

Q. I believe they were just general like that one picture of the billiards game.

A. I specifically wonder when I first showed the

differentiators. That is really not significant in the wall bounce in that we are not trying to change speed.

Q. In fact, I believe there was a note that said you wanted to keep the same velocity?

A. Right, I was on this track because I do see a differentiator and integrator in Exhibit 23-132, but they would be more involved in the nudging or stroking or kicking action feature as would Exhibit 23-137. I am hesitating because I am trying to figure out whether or not an integrator was necessary in this wall bounce action and I believe it was in that for a hit spot or any spot for that matter to continue along a straight line, its horizontal and/or vertical deflection voltages would have to be either increasing or decreasing at a constant rate. One of the ways which comes to mind now and apparently did back in December of 1967 or thereabouts would be to feed a constant voltage to the input of an integrator. When this is done, the integrator output will be a constant slope increasing or decreasing voltage as shown on page 18 of Exhibit 19. These integrators labeled

there as ball horizontal integrator and ball vertical integrator do appear necessary. Also as shown on that page 18, the constant input voltage to one of these integrators, for example, would be either a plus value or a minus value and changing from one to the other when and if the ball hit the side of the walls as labeled with those words in the center of page 18. As implemented or as conceived about that time, at least, I would think that the differentiators shown to the left of page 18 in Exhibit 19 would also be associated with the wall bounce in that for most of these games, something had to get the spot moving and at least, as shown on page 18, it was when a hitting spot hit the ball. This then did set the velocity of the ball after being hit. To be more specific, if desired, the output of the differentiator circuit is a voltage whose magnitude depends on the speed of the hitting spot. Again on page 18 as shown, this voltage becomes the input, for example, to the horizontal integrator of the ball with a polarity of either plus or minus as shown by the two triangular boxes marked thusly. I went to all that

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trouble because in looking through Bill Harrison's material, this Exhibit No. 23 which was handed to me, I do see references made to differentiators, integrators, gates and flipflops, specifically in Exhibit 23-137 dated 11-28-67. There does seem to be a more or less exact representation of page 18 in Exhibit No. 19, perhaps exact is not the right word. On page 18 of Exhibit 19 there is a block diagram showing the wall bounce feature as just discussed. This block diagram involves differentiators, plus or minus gain amplifiers, flipflops. We changed the ball's direction when the sides or walls are hit and horizontal and vertical integrators maintain the ball speed or velocity constant at its initial value when hit - or rather its initial value it assumed when it was hit. I do see a penciled cross through the circuitry on Mr. Harrison's Exhibit 23-137 which may indicate that the circuitry didn't work perfectly, but I at least would assume it was being tried at that time. The date on that page is 11-28-67.

Q. Which is the date prior to the 12-11-67 date of page 18 of Exhibit 19, is that correct?

A. Correct.

Q. Is it possible that since that date is prior, that that wall bounce feature was thought of by Mr. Harrison?

A. I do not believe so. I consider that definitely my idea, with the differentiators and integrators, no matter what these pages show.

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Q. Of course, it is possible that, as you have indicated earlier, there are other entries to indicate wall bounce prior to the 11-28-67 date of Exhibit 23-137?

A. Yes. It is possible that I had put my concepts of this on scraps of paper and perhaps I waited until it looked like it was really going to pay off before entering it in the notebook, but I do definitely feel that that was my contribution, at least conceptually, but definitely Mr. Harrison helped implement the theory.

Q. Now, Exhibit 23-137 has the title at the top circuitry to cause movement realistically when paddle hits ball. Is it possible that that circuitry was intended to function only for that purpose without an additional flipflop and other circuitry to respond in the event that the ball hit side walls

as you referred to Exhibit 19-18?

A. I don't think so. These items or rather transistors labeled gate in Exhibit 23-137 are driven from a flipflop and I believe the intent was that one or the other gate would conduct depending on the state of that flipflop and I do feel that the function of the gates shown there was meant to carry out functions shown as plus one and minus one in the triangles on page 18 of Exhibit 19. I can't really see why they would be in there unless it was to provide this wall bounce feature.

Q. Do you find among Mr. Harrison's notes any other indication of implementation of the wall bounce feature than that represented on 23-137?

A. I will start looking at exhibits with higher numbers than that shown up to now. I believe Exhibit 23-139 may have been an attempt toward this direction in that I see a differentiator and an integrator and a flipflop which is labeled triggered from coincidence circuit, but I don't really see the gates which would change polarity when the wall is hit. I see that this page also has a pencil cross through it, so it may or may not have been an

attempt in this direction. On the next exhibit, 23-140, I do see such gates. Preceding them is what I believe to be a differentiator similar to the capacitor resistor differentiator shown at the input of page 18 of Exhibit 19.

Q. Where are the gates on Exhibit 23-40?

A. Starting at the left, they would be the second and third transistors, one of which is a PNP transistor, the other of which is an NPN transistor. The emitters of both transistors are connected together as are their collectors.

Q. And you say preceding those is a differentiator?

A. Yes.

MR. WELSH: Off the record.

(Discussion off the record.)

THE WITNESS: To the left of Exhibit 23-140 is a transistor with a feedback resistor going from its collector to its base. There is a capacitor going from the base toward the left side of the page. This transistor with its feedback and that capacitor constitute a differentiator. Similarly the two right-hand transistors of that

circuit, or more specifically, the second from the right, in conjunction with the one microfarad capacitor attached from its base to ground appear to me, at least, to perform the integration function shown in the boxes to the right of page 18 of Exhibit 19. I believe the two transistors right to the left of that one microfarad capacitor are there just to provide paths for the positive or negative pulses which come out of the paralleled gates. It may or may not be significant, but I think the little penciled notation at the top of that exhibit, delta* Ec equals DH1*, DTR* in my handwriting. wfc* I can't be sure at this time. Similarly at an angle over to the right of the page I see the mathematical expression E equals 1 divided by C times the integral of IDT. $i\,dt$ I think I recognize that as my handwriting, although naturally I can't be certain, but I would think I possibly made these two comments while Bill Harrison and I were talking about trying to make this circuitry work. wfc 5/25/76

Q. There is also a pencil cross through that circuitry in Exhibit 23-140, is there not?

A. Correct. At least part of this Exhibit 23-141

* check exhibit for exact writing of $\Delta E_c = \frac{dH_1}{dt}$ etc.
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I think is my writing. Is this getting down to too much detail where we need handwriting experts?

Q. No, I don't think we will go into that.

A. I think like the expression integrator or int., the upper part of that page, and the d/dt and gate and several other items, even possibly the resistors and the capacitors may have been in my handwriting. This might have been a scrap of paper I used in talking with Bill about this, but I am not sure.

Q. Does that exhibit also relate to wall bounce?

A. Let me see, I assume it did, but let me check. I think so. There is a circled portion with d/dt next to it which is very similar to the differentiator we just discussed on the previous exhibit. Over at the right there is a transistor circuit labeled integrator or int. which looks more like an integrator even than the one in Exhibit 23-140.

Q. I believe there is some sketching on the back of 23-140 that you did not refer to.

A. I didn't see it.

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Q. Does that have any relation to the ball bounce feature?

A. Yes, I believe so.

William T. Rusch*

* Corrected for artist

Q. Could you go quickly through the rest of the notes?

A. I would like to say on the back of this page that you were just talking about, on the back of page 23-140, it looks to me like I drew that rather sparse sketchy upper diagram and I think that the more specific one showing actual transistors and diodes was most probably drawn by Bill Harrison, being this is in his collection of papers. I didn't draw the bottom one, but I think I probably did the top one. Again I think it might have been while we were discussing reduction of these concepts to practice. We have done 23-141.

MR. WILLIAMS: Mr. Welsh, I note that there seems to be a lot of documents left to go and it is after one o'clock.

MR. WELSH: All right; I guess then we had better stop. We will have to determine I guess by communicating with each other when we can resume.

(Whereupon, the deposition in the above-entitled matter was adjourned at 1 p.m.)

William T. Rusch*

Deponent

* Corrected to extent covered by note in Depo. 8, p. 47

THE STATE OF NEW HAMPSHIRE)
) SS.
COUNTY OF Hillsborough)

Subscribed and sworn to before me this 28

day of May 1976.

VIRGINIA J. MURPHY, Notary Public

Virginia J. Murphy

My Commission Expires September 26, 1979

Justice of the Peace and/or
Notary Public